

## CLAIMS

1. An isolated nucleic acid sequence comprising SEQ. ID. NO. 1.
2. A hydrogenase having an amino acid sequence comprising SEQ. ID. NO. 4.
3. An isolated nucleic acid sequence comprising SEQ. ID. NO. 7.
4. An isolated nucleic acid sequence comprising SEQ. ID. NO. 2.
5. A hydrogenase having an amino acid sequence comprising SEQ. ID. NO. 5.
6. An isolated nucleic acid sequence comprising SEQ. ID. NO. 8.
7. An isolated nucleic acid sequence comprising SEQ. ID. NO. 3.
8. A hydrogenase having an amino acid sequence comprising SEQ. ID. NO. 6.
9. An isolated nucleic acid sequence comprising SEQ. ID. NO. 9.
10. A cell comprising an isolated nucleic acid sequence encoding a protein comprising SEQ. ID. NO. 4.
11. A cell comprising an isolated nucleic acid sequence encoding a protein comprising SEQ. ID. NO. 5.
12. A cell comprising an isolated nucleic acid sequence encoding a protein comprising SEQ. ID. NO. 6.
13. A photosynthetic process for hydrogen production comprising the steps of: (a) growing a microorganism containing a gene coding for HydA having a nucleic acid sequence set forth in SEQ. ID. NO. 1 in a culture medium containing nutrients under illuminated conditions sufficient to accumulate an endogenous substrate; then (b) depleting a nutrient in the culture medium selected from the

1 group consisting of sulfur, iron, and manganese; then (c) allowing the culture  
2 to become anaerobic by consumption of an endogenous or exogenous  
3 substrate in the light.

4 14. The photosynthetic process for hydrogen production in accordance with claim  
5 13 wherein said nucleic acid sequence comprises SEQ. ID. NO. 2.

6 15. The photosynthetic process for hydrogen production in accordance with claim  
7 13 wherein said nucleic acid sequence comprises SEQ. ID. NO. 3.

8 16. A photosynthetic process for hydrogen production comprising the steps of: (a)  
9 growing a microorganism producing a Fe-Hydrogenase enzyme comprising an  
10 amino acid sequence sequence set forth in SEQ. ID. NO. 4 in a culture  
11 medium containing nutrients under illuminated conditions sufficient to  
12 accumulate an endogenous substrate; then (b) depleting a nutrient in the  
13 culture medium selected from the group consisting of sulfur, iron, and  
14 manganese; then (c) allowing the culture to become anaerobic by consumption  
15 of an endogenous or exogenous substrate in the light.

16 17. The photosynthetic process of claim 16 wherein said amino acid sequence of  
17 said Fe-Hydrogenase enzyme comprises an amino acid sequence as set forth  
18 in SEQ. ID. NO 5.

- 1 18. The photosynthetic process of claim 16 wherein said amino acid sequence of  
2 said Fe-Hydrogenase enzyme comprises an amino acid sequence as set forth  
3 in SEQ. ID. NO 6.
- 4 19. An isolated amino acid sequence selected from the group consisting of SEQ  
5 ID NO. 4, SEQ ID NO. 5, or SEQ ID NO. 6.
- 6 20. An isolated amino acid sequence with 75% or more sequence homology to a  
7 polypeptide selected from the group consisting of SEQ ID NO. 4, SEQ ID  
8 NO. 5, or SEQ ID NO. 6.

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